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That I am knowledgeable in the German language in which the below identified international application was filed, and that, to the best of my knowledge and belief, the English translation of the international application No. PCT/DE2004/000767 is a true and complete translation of the above identified international application as filed.

I hereby declare that all the statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the patent application issued thereon.

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Rechargeable battery and method for production of a
sealed contact terminal bushing

5 The invention relates to a rechargeable battery having
at least one cell in a housing, and having contact
elements which are electrically connected to at least
one cell and are passed through a housing wall, with
each of the contact elements being extrusion-coated
with a plastic sealing element, and the plastic sealing
10 elements each having a supporting surface which lies
flat on the housing wall.

15 The invention also relates to a method for production
of a sealed contact terminal bushing for rechargeable
batteries, with the contact terminals being
electrically connected to at least one cell and being
passed through a housing wall.

20 Gas-tight and liquid-tight pole seals for rechargeable
batteries are known from DE 28 33 416 B1 and
EP 0 105 416 B1, in which the pole bolts which are used
to make contact with the cells are extrusion-coated
with a body composed of a thermoplastic. The body is
brought into contact with the housing cover of the
25 rechargeable battery and is welded using the hot-tool
welding process, thus forming a circumferential welded
edge on the outside between the body and the cover.
Ultrasound welding processes or friction welding
processes have also been proposed, instead of the hot-
30 tool welding process.

These pole seals are suitable for lead-acid
rechargeable batteries but not, in contrast, for nickel
metal hydride (NiMH) and lithium-ion batteries owing to
35 the materials used (for example nickel, aluminum,
copper, steel).

One object of the invention is thus to provide an

improved rechargeable battery, in particular a nickel metal hydride or lithium-ion rechargeable battery, having at least one cell in a housing and having contact elements, with the contact elements being
5 passed through a housing wall, such that a seal is formed.

The object is achieved according to the invention by the rechargeable battery of this generic type in that
10 the supporting surface is transmission laser-welded as a first welded part to the housing wall which is directly adjacent to it, and has a second welded part by means of a weld bead, which is circumferential around the contact element on the contact surface
15 between the supporting surface and the housing wall, and one of the two welded parts is at least partially transparent for the laser beam and the other welded part is absorbent for the laser light, so that the supporting surface can be welded by means of a laser
20 beam and absorption on the supporting surface to the housing wall as the laser beam passes through the other adjacent welded part.

With the aid of the transmission laser welding method, which is in principle known, for example from
25 DE 199 16 786 A1, for connection of vertical tubular and/or wall elements composed of laser-transparent and/or laser-absorbent plastic, it is possible to produce a non-contacting, wear-free joint between a
30 plastic sealing element and housing wall with as little heat as possible being introduced. The transmission laser welding method requires only short process times, and is thus relatively fast. Furthermore, the tooling costs are low, and the transmission laser welding
35 method offers high flexibility during manufacture.

The welding of the supporting surface of the plastic sealing element to the housing wall by means of a weld

bead on the contact surface between the supporting surface and the housing wall instead of the weld bead, which is produced in conventional hot-tool welding, to the outer edge furthermore has the advantage that no
5 dead space is required and the plastic sealing element can be welded to the housing wall only by means of the transmission laser welding method, for manufacturing reasons.

- 10 It is advantageous for the contact elements to have circumferential projections on their circumference, and for the plastic sealing element to completely surround the projections. This results in sealing against gas and liquid that is better than that when using
15 extrusion-coating of a smooth contact element. Alternatively or additionally for this purpose, the contact elements may also have circumferential depressions on their circumference, with the plastic sealing element completely filling the depressions,
20 once this has been extrusion-coated around the contact element in the area of the projections and/or depressions.

- 25 In order to improve the absorption characteristics, the supporting surface of the plastic sealing element and/or the housing wall preferably has additives or fillers in the area of the associated supporting surface. Alternatively or additionally for this purpose, a colored layer which absorbs laser light can
30 also be provided in order to improve the absorption characteristics on the supporting surface and/or on that surface of the housing wall which abuts directly onto the supporting surface.

- 35 When the laser light passes through the housing wall, which is transparent to laser light, it is absorbed or possibly partially reflected on the laser-light-absorbent supporting surface of the plastic sealing

element, such that the supporting surface is heated and is welded to the adjacent housing wall.

5 However, the laser beam can also be absorbed on the boundary surface between the housing wall and the plastic sealing element, so that the entire surface of the housing wall is heated.

10 It is particularly advantageous for the plastic sealing element to have grooves for holding the housing wall. The plastic sealing element can then be clamped to the housing wall in a liquid-tight manner by means of the grooves in the area of an aperture through the housing wall. This embodiment is particularly suitable for cell
15 connectors which are passed from one cell through an intermediate wall to the adjacent cell. In this case, it is not absolutely essential for the grooves to be welded to the housing wall. The grooves can thus advantageously be used in those areas which are not
20 accessible for the transmission laser welding method during manufacture.

The contact elements are preferably pole bolts which are passed outwards through a housing cover, or cell
25 connectors which are passed through an intermediate wall in the battery housing for connection of adjacent cells.

Another object of the invention is to provide an
30 improved method for production of a sealed contact terminal bushing for rechargeable batteries as described above.

The object is achieved by the steps of:

35

- extrusion coating of the contact terminals with a plastic sealing element with the plastic sealing element having a supporting surface which can rest

flat on the housing wall.

- application of the supporting surface of the plastic sealing element to the housing wall,
- 5 - transmission laser welding of the supporting surface to the immediately adjacent housing wall by means of a laser beam, which strikes the supporting surface through the at least partially transparent housing wall, which supporting surface is absorbent such that it is welded to the adjacent housing wall, with the weld bead running around the contact element and lying on the contact surface between the supporting surface and the housing wall.

Thus, according to the invention, in a conventional contact terminal bushing which is extrusion-coated with a plastic sealing element, the plastic sealing element which rests on the housing wall is welded in place by means of a transmission laser welding method. In this case, the laser light is passed through the at least partially transparent housing wall to a supporting surface which absorbs laser light. The supporting surface is heated by the absorption and possibly partial reflection of the laser light, so that the supporting surface is welded to the adjacent housing wall on the contact surface between the supporting surface and the housing wall.

30 In order to improve the absorption characteristics, additives or fillers can be introduced into the plastic material before the extrusion coating of the contact terminals. However, it is also possible to apply a colored layer, which absorbs laser light, to the supporting surface and/or to that surface of the housing wall which is intended to make contact with the supporting surface, in order to improve the absorption

characteristics.

In particular in order to mount the contact terminal bushing on the housing wall in a liquid-tight manner at points which are not accessible for the transmission laser welding method, it is advantageous to incorporate grooves in the plastic sealing element and to clamp the plastic sealing element onto the housing wall by means of the grooves. It is then no longer absolutely essential to carry out any further welding in the area of the grooves.

The invention will be explained in more detail in the following text using the attached drawings, by way of example, in which:

Figure 1 shows a perspective view of a rechargeable battery with a plastic housing and with pole bolts which are passed out of the plastic housing; and

Figure 2 shows a section view through a detail of the rechargeable battery shown in Figure 1.

Figure 1 shows a rechargeable battery 1 with a plastic housing 2 which is closed such that it is liquid-tight and gas-tight, and through which pole bolts 3a, 3b are passed for electrical connection of the rechargeable battery 1. The pole bolts 3a, 3b project through the housing cover 4 of the plastic housing 2, and out of it. They are extrusion-coated with a plastic sealing element 5, part of which is passed to the exterior through a hole in the housing cover 4.

According to the invention, the plastic sealing elements 5 are welded to the housing cover 4 using a transmission laser welding method, by passing a laser beam through the housing cover 4, which is at least

partially transparent for laser light, with the laser beam striking the supporting surface for the plastic sealing element 5, which rests on the housing cover 4. This supporting surface for the plastic sealing element 5 absorbs laser light so that heat is produced, which melts the supporting surface of the plastic sealing element 5 and welds it to the housing cover 4. The weld bead 0 produced in this way is located on the contact surface between the supporting surface of the plastic sealing element 5 and the housing cover 4 and runs circumferentially, without any seam, around the pole bolts 3a and 3b. In order to produce this weld bead 6, the housing cover 4 is pressed, for example by means of a clamping apparatus, onto the plastic sealing element 5 such that a contact is ensured between the supporting surface and the housing cover 4 during the transmission laser welding.

In order to ensure adequate absorption of the contact surface, the plastic sealing element 5 may have appropriate additives or fillers, in particular on the supporting surface. However, it is also feasible to increase the absorption and possibly reflection characteristics of the contact surface between the supporting surface of the plastic sealing element 5 and the housing wall, for example the housing cover 4, by the application of ink, preferably using a colored layer which absorbs laser light.

Figure 2 shows a section view through a detail of the rechargeable battery 1 shown in Figure 1. As can be seen clearly, this shows that the plastic sealing element 5 is extrusion-coated around the circumference of the pole bolt 3 such that it is liquid-tight and gas-tight. In this case, depressions in the form of circumferential grooves are provided on the circumference of the pole bolt 3, and are completely filled by the plastic sealing element 5. The plastic

sealing element 5 has a flange with a supporting surface which rests flat on the inner face of the housing cover 4. In the area of the flange, the plastic sealing element 5 is connected by means of a seamlessly circumferential weld bead 6 to the housing cover 4, using a transmission laser welding method. This ensures a liquid-tight and gas-tight bushing for the pole bolt 3 through the housing cover 4.

As can also be seen, a cell connector 7 is provided for the electrical connection to the left-hand cell 8a and the right-hand cell 8b. This cell connector 7 is passed through an intermediate wall 9 which has an aperture for the cell connector 7. The cell connector 7 is extrusion-coated with a plastic sealing element 5, in which case additional depressions or grooves are likewise provided, and are completely filled by the plastic sealing element 5.

A groove 10 is provided on the side edges and the lower edge of the plastic sealing element 5 in order to clamp the plastic sealing element 5 onto the intermediate wall 9, such that it is liquid-tight. There is then no longer any need for welding in the area of the groove 10. The plastic sealing element 5 is just welded on the supporting surface to the housing cover 4, by means of the transmission laser welding method.

The cell connectors 7 may be formed from one or more parts. Contact may be made with the cell connectors 7 using detachable or rigid processes in a known manner, for example by means of screws, rivets, welds, clinches, pressing or bevel-bend joining.

Furthermore, filling openings 11 and valve openings 12 may be provided in a known manner in the housing cover 4. These filling and valve openings 11, 12 can also advantageously be transmission laser-welded.

Patent Claims

1. A rechargeable battery (1) having at least one cell (8a, 8b) in a housing (2), and having contact elements (3, 7) which are electrically connected to at least one cell (8a, 8b) and are passed through a housing wall (4, 9), with each of the contact elements (3, 7) being extrusion-coated with a plastic sealing element (5), and the plastic sealing elements (5) each having a supporting surface which lies flat on the housing wall (4, 9) **characterized in that** the supporting surface is transmission laser-welded as a first welded part to the housing wall (4, 9) which is directly adjacent to it, and has a second welded part by means of a weld bead, which is circumferential around the contact element (3, 7) on the contact surface between the supporting surface and the housing wall (4, 9), and one of the two welded parts is at least partially transparent for the laser beam and the other welded part is absorbent for the laser light, so that the supporting surface can be welded by means of a laser beam and absorption on the supporting surface to the housing wall (4, 9) as the laser beam passes through the other adjacent welded part.
2. The rechargeable battery (1) as claimed in claim 1, **characterized in that** the contact elements (3, 7) have circumferential projections on their circumference, and the plastic sealing element (5) completely surrounds the projections.
3. The rechargeable battery (1) as claimed in claim 1 or 2, **characterized in that** the contact elements (3, 7) have circumferential depressions on their circumference, and the plastic sealing element (5) completely fills the depressions.
4. The rechargeable battery (1) as claimed in one of

the preceding claims, **characterized in that** the supporting surface of the plastic sealing element (5) and/or the housing wall (4, 9) have/has additives or fillers in order to improve the absorption characteristics in the area of the associated supporting surface.

5. The rechargeable battery (1) as claimed in one of the preceding claims, **characterized in that** the supporting surface and/or that surface of the housing wall (4, 9) which abuts directly onto the supporting surface has a colored layer, which absorbs laser light, in order to improve the absorption characteristics.

6. The rechargeable battery (1) as claimed in one of the preceding claims, **characterized in that** the contact elements (3, 7) have grooves for holding the housing wall (4, 9), and the contact elements (3, 7) are clamped to the housing wall (4, 9) in a liquid-tight manner by means of the grooves in the area of each aperture through the housing wall (4, 9).

7. The rechargeable battery (1) as claimed in one of the preceding claims, **characterized in that** the contact elements (3, 7) are pole bolts (3) or cell connectors (7).

8. A method for production of a sealed contact terminal bushing for rechargeable batteries (1), with the contact terminals (3, 7) being electrically connected to at least one cell (8a, 8b) and being passed through a housing wall (4, 9), having the following steps:

- extrusion coating of the contact terminals (3, 7) with a plastic sealing element (5) with the plastic sealing element (5) having a supporting surface which can rest flat on the housing wall

(4, 9).

- 5 - application of the supporting surface of the plastic sealing element (5) to the housing wall (4, 9),
- 10 - transmission laser welding of the supporting surface to the immediately adjacent housing wall (4, 9) by means of a laser beam, which strikes the supporting surface through the at least partially transparent housing wall (4, 9), which supporting surface is reflective such that it is welded to the adjacent housing wall (4, 9), with the weld bead running around the contact element (3, 7) and
- 15 lying on the contact surface between the supporting surface and the housing wall (4, 9).
- 20 9. The method as claimed in claim 8, **characterized by** introduction of additives or fillers into the plastic material for the plastic sealing element (5) in order to improve the absorption characteristics.
- 25 10. The method as claimed in claim 8 or 9, **characterized by** application of a colored layer, which absorbs laser light, to the supporting surface and/or that surface of the housing wall (4, 9) which is intended to make contact with the supporting surface, in order to improve the absorption characteristics.
- 30 11. The method as claimed in one of claims 8 to 10, **characterized by** introduction of grooves into the plastic sealing element (5) in order to hold the housing wall (4, 9) and liquid-tight clamping of the plastic sealing element (5) to the housing wall (4, 9),
- 35 by means of the grooves, in the area of an aperture through the housing wall (4, 9).

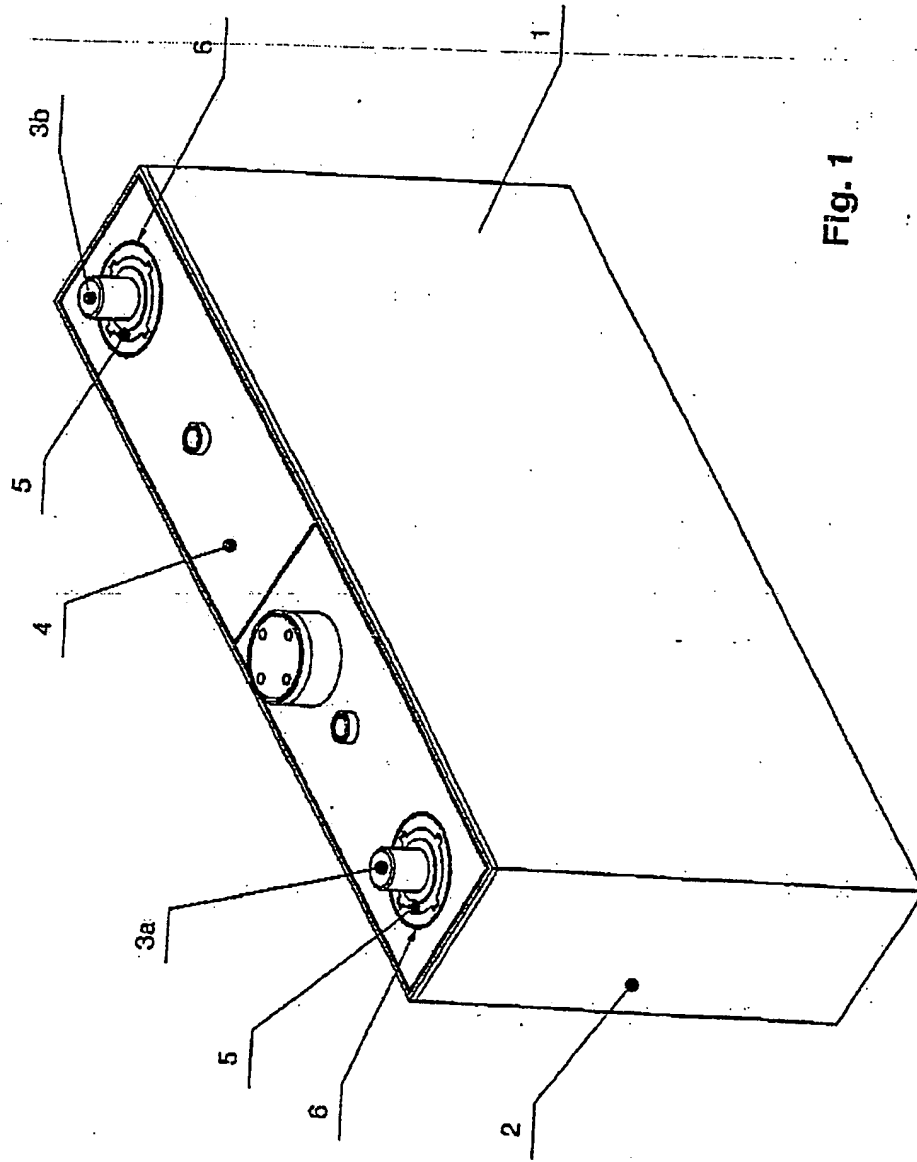


Fig. 1

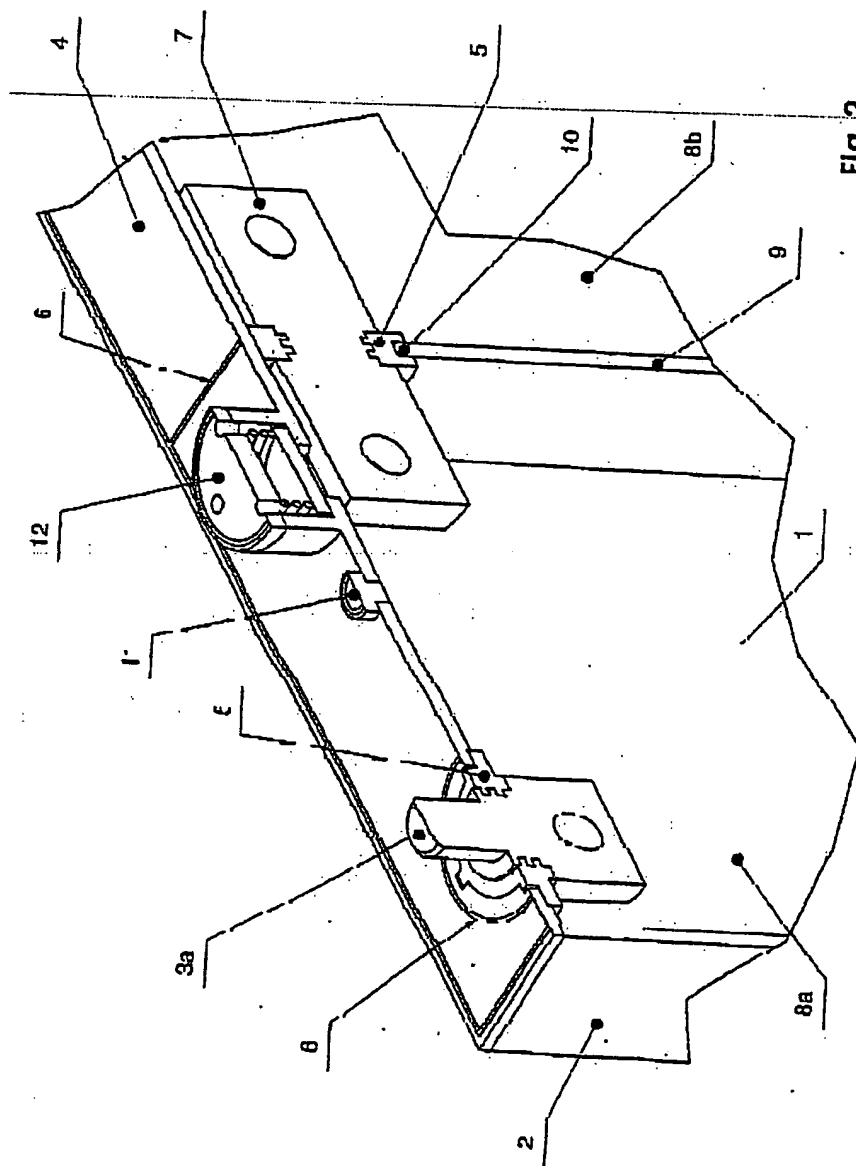


Fig. 2